

## CLAIMS

- 1           1. A method to pattern a workpiece with improved CD uniformity using a  
2           partially coherent electromagnetic radiation source, including the  
3           actions of:
- 4           - determining, for a plurality of layers in said workpiece, CD
  - 5           uniformity as a function of a number of exposure flashes,
  - 6           - determining, for a plurality of layers in said workpiece, the
  - 7           cost of patterning as a function of the number of exposure
  - 8           flashes,
  - 9           - selecting the number of exposure flashes on a layer by layer
  - 10          basis, which gives a predetermined CD uniformity
  - 11          corresponding to a preferred cost.
- 1           2. The method according to claim 1, further comprising the action of:
- 2           - selecting a combination of values of the following
  - 3           parameters:
  - 4
    - radiation bandwidth
    - 5           • pulse length
    - 6           • radiation flash frequency
  - 7           so that a calculated illumination non-uniformity (3 sigma) from
  - 8           speckle amounts to less than 0.5%.
- 1           3. The method according to claim 1 or 2, further comprising the action of:
- 2           - determining a value of a slit width so that a calculated
  - 3           illumination non-uniformity (3 sigma) from speckle amounts
  - 4           to less than 0.5%.

1 4. A computer assisted apparatus for printing a workpiece with improved  
2 CD uniformity by using a partially coherent radiation source,  
3 comprising:

- 4 - logic and resources that determine, for a plurality of layers in  
5 said workpiece, CD uniformity as a function of the number of  
6 exposure flashes,
- 7 - logic and resources that determine, for the plurality of layers  
8 in said workpiece, a cost of patterning as a function of the  
9 number of exposure flashes,
- 10 - logic and resources that select the number of exposure flashes  
11 on a layer by layer basis, which gives a predetermined CD  
12 uniformity at a minimum of patterning cost.

1 5. A method for printing a workpiece with improved CD-uniformity,  
2 including the action of:

- 3 - changing a number of exposure flashes per surface element  
4 on a layer by layer basis.

1 6. A method for printing a workpiece with improved CD-uniformity,  
2 including the action of:

- 3 - changing a pulse length of exposure flashes per surface  
4 element on a layer by layer basis.

1 7. A method for printing a workpiece with improved CD-uniformity,  
2 including the action of:

- 3 - changing a radiation bandwidth of exposure flashes per  
4 surface element on a layer by layer basis.

1           8. A method for printing a workpiece with improved CD-uniformity,  
 2           including the action of:  
 3           - changing a slit width of exposure flashes per surface element  
 4           on a layer by layer basis.

1           9. The method according to any one of claims 5-8, wherein said changing  
 2           is performed for critical layers in the microelectronic device only.

1           10. A procedure to improve CD uniformity of a layer exposed in a scanner  
 2           or stepper using partially coherent light, including the actions of:

3           - providing a scanner system with an optical field larger than 10 mm,  
 4           - increasing one or more of the following parameters

- 5           a. slit width,
- 6           b. laser bandwidth,
- 7           c. pulse length,
- 8           d. laser flash frequency,
- 9           e. number of flashes,
- 10          f. number of flashes per field,
- 11          g. number of scan cycles per field

12          until the calculated illumination non-uniformity (3 sigma) from speckle  
 13          amounts to less than 0.5%.

1           11. The procedure as in claim 10 but with calculated speckle less than 1%.

1           12. The procedure as in claim 10 but with calculated speckle less than 2%.

1           13. The procedure as claimed in claim 10 but with calculated speckle less than  
 2           3%.

- 1 14. The procedure according to claim 10, wherein non-polarised light is used.
- 1 15. The procedure according to claim 10, wherein refractive optics is used.
- 1 16. The procedure according to claim 15, wherein at least one diffractive  
2 element is used.
- 1 17. The procedure according to claim 15, wherein catadioptric optics with at  
2 least one diffractive element is used.
- 1 18. A procedure to improve CD uniformity of a layer exposed in a maskless  
2 scanner using partially coherent light comprising the steps of:
- 3 - providing a maskless scanner systems with an optical field larger than  
4 0.5mm,
- 5 - increasing one or more of the following parameters:
- 6 a. laser bandwidth,
- 7 b. pulse length,
- 8 c. number of overlaid flashes,
- 9 until the calculated illumination non-uniformity (3 sigma) from speckle  
10 amounts to less than 0.5%.
- 1 19. The procedure according to claim 18, wherein said calculated speckle is less  
2 than 1%.
- 1 20. The procedure according to claim 18, wherein said calculated speckle is less  
2 than 2%.
- 1 21. The procedure according to claim 18, wherein said calculated speckle is less  
2 than 3%.
- 
- 1 22. The procedure according to claim 18, wherein non polarized light is used.
- 1 23. An apparatus for printing a workpiece with improved CD uniformity  
2 including:

- 3       - logic and resources to calculate the speckle,
- 4       - logic and resources that change the number of pulses per surface element on
- 5       a layer to layer basis.

1       24. A procedure for optimizing the speckle during microlithographic printing  
2       including the actions of:

- 3       - providing a model for the value of improved CD uniformity,
- 4       - calculating the CD uniformity as a function of the number of flashes,
- 5       - providing a model for the cost of printing with a particular number of
- 6       pulses,
- 7       - providing logic and resources that select a number of flashes that
- 8       corresponds to a preferred result,
- 9       - providing a control adapted to change the number of flashes, and
- 10      - setting said approximately optimized number of flashes.

1       25. An electronic device with improved CD uniformity printed with speckle less  
2       than 1% (3 sigma).

1       26. The method according to claim 23, further including the actions of:

- 2       - determining, for a plurality of layers in said workpiece, CD uniformity as a
- 3       function of a number of exposure flashes,
- 4       - determining, for the plurality of layers in said workpiece, the cost of
- 5       patterning as a function of the number of exposure flashes,
- 6       - selecting the number of exposure flashes on a layer by layer basis, which
- 7       gives a predetermined CD uniformity corresponding to a preferred cost.